

Assistant Professor investigating the neural circuitry behind the intersection of sleep and pain; Assistant Director for Undergraduate Research & Education.
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Education

Thomas Jefferson University, Philadelphia, PA	Sep 2015
Ph.D. in Neuroscience, Thesis Lab : Dr. Michael Oshinsky & Dr. Melanie Elliott	
Honors College of Drexel University, Philadelphia, PA	June 2008
Bachelor of Science in Biological Sciences (minor in Mathematics)	

Honors & Awards

IRACDA Annual Conference Poster Award	2018	Fredric Rieders Renaissance Foundation Graduate Student Award	2014
Digital Teaching Fellowship Rutgers-Camden (\$1500)	2018	TJU Alumni Travel Grant (\$1000)	2014
Cornell CrawFly Invertebrate Neurophys Scholarship (\$1500)	2018	American Headache Society Travel Grant (\$1500)	2013
Jefferson JCBS Alumni Thesis Award	2016	Seahorse Bioscience Travel Grant (\$1500)	2012
North American Pain School Trainee (\$1500)	2016	TJU Alumni Travel Grant (\$1000)	2014
North American Pain School Pain Research Forum Correspondent	2016	AAAS Mass Media Science & Engineering Fellows Finalist	2011
New Headache Investigator Research Tournament Winner	2015	Leopold Schepp Foundation Graduate Grant (\$20000)	2010 - 2011
International Headache Academy Young Investigator	2015	1 st prize in College of Arts & Science Research Day	2008
NIH Pain Consortium Symposium Travel Grant (\$1000)	2014	Featured in Drexel Alumni Donor Magazine article	2008
CLS Capitol Hill Day Travel Grant (\$1000)	2014	Leopold Schepp Foundation Scholarship (\$20000)	2007 - 2008
Hosted Congressman Charlie Dent for tour of TJU	2014	TriBeta-BIO Honor Society	2007 - 2008

Research/Training Support

NIH IRACDA K12 PENN-PORT Postdoctoral Fellowship (K12 GM081259) (\$190,488) "Determining the role of fibroblasts in chronic pain and migraine"	2016 - 2019
Thomas Jefferson Headache Center Miles for Migraine Grant (\$15,000 collaborative project between TJU & UPENN) "Investigating the role of non-peptidergic C-fiber nociceptors in Post-Traumatic Headache"	2016
NIH Mentoring Junior Investigators in Alcohol Research Fellowship (T32 AA007463) (\$105,300) "Mitochondrial Dysfunction & Adenosine Signaling in Delayed Ethanol-Induced Headache"	2012 - 2015

Publications

- Fried NT**, Elliot MB, Oshinsky ML. "The Role of Adenosine Signaling in Headache: a Review." *Brain Sci. The Pathogenesis and Treatment of Headache Disorders special issue* 2017, 7(3), 30.
- Fried NT**, Maxwell CR, Elliot MB, Oshinsky ML. "Region-specific disruption of the blood-brain barrier following repeated inflammatory dural stimulation in a rat model of chronic trigeminal allodynia." *Cephalalgia* April 2017.
- Fried NT**, Moffat C, Seifert EL, Oshinsky ML. "Functional Mitochondrial Analysis in Acute Brain Sections from Adult Rats Reveals Mitochondrial Dysfunction in a Rat Model of Migraine." *Am J Physiol Cell Physiol* 2014, 307(11):C1017-30.
- Talati PG, Hoang DT, **Fried NT**, Magee MS, Fineberg JD. "A Perspective on PhD Career Outlook: Training, Mentoring and Utilizing a New Generation of STEM Doctoral Degrees." *Technology Transfer and Entrepreneurship* 2014, 1(2):138-143.
- Hirata H, **Fried NT**, Oshinsky ML. "Quantitative characterization reveals three types of dry-sensitive corneal afferents: pattern of discharge, receptive field, thermal and chemical sensitivity." *Journal of Neurophysiology* 2012, 108(9):2481-93.

Manuscripts in Preparation/Review

- Abdus-Saboor I*, **Fried NT***, Lay M, Dong P, Burdge J, Lu M, Ma M, Dong X, Long D, Luo W. "High-Speed Imaging of Paw Withdrawal Reflex to Objectively Assess Pain State in Mice." *These authors contributed equally. In Revision at *Cell Reports*. Available in *bioRxiv preprint repository*
- Fried NT**, Maxwell CR, Oshinsky ML. "The metabolite of ethanol, acetate, induces the hangover headache via adenosinergic signaling within the brainstem." *In final preparation for submission to JNeuro*.
- Fried NT**, Cooper M, Oshinsky ML. "Repeated infusion of prostaglandin E2 alone onto the dura induces chronic trigeminal sensitivity via TRPA1 channels." *In final preparation for submission to Pain*.
- Fried NT**, Daiutolo BV, Oshinsky ML, Elliott MB. "Central Sensitization in a Traumatic Brain Injury Model." *In final preparation for submission*.
- Fried NT**, Perino J, Oshinsky ML, Daugherty B, Lederman S, Elliott MB. "The (R)-enantiomer of isometheptene relieves trigeminal sensitivity and alters pain signaling molecules in the trigeminal system of two rat models of trigeminal pain." *In final preparation for submission*

Invention Disclosures

- A mouse pain scale: method, software, and device**, co-inventor (filed in June 2018 to the University of Pennsylvania Center for Innovation)

Poster Presentations of Research

- Fried NT**, Abdus-Saboor I, Dong P, Burdge J, Lu M, Ding L, Luo W. "A Mouse Pain Scale: Assessment of Pain Sensation in Mice Using Sub-second Behavioral Mapping and Statistical Modeling." July 2018 NIH IRACDA Annual Conference, Atlanta, GA. *Received Poster Award
- Abdus-Saboor I, **Fried NT**, Dong P, Burdge J, Lu M, Ding L, Luo W. "High resolution mapping of sub-second behavior features of mouse paw withdrawal." November 2017 Society for Neuroscience Annual Meeting, Washington DC.
- Green A, **Fried NT**, Luo W. "Using optogenetics to investigate the interactions between fibroblasts and c-fibers in the development of chronic pain." November 2017 Annual Biomedical Research Conference for Minority Students (ABRCMS), Phoenix AZ.
- Perino J, **Fried NT**, Oshinsky ML, Daugherty B, Lederman S, Elliott MB. "The (R)-isomer of isometheptene decreases trigeminal sensitivity in a rat model of primary headache." June 2016 American Headache Society Annual Scientific Meeting, San Diego, CA.
- Hann S, **Fried NT**, Venkatesan L, Oshinsky ML. "Effectiveness of 'Burst' Occipital Nerve Stimulation in Treating Allodynia in a Rodent Model of Migraine." December 2015 The North American Neuromodulation Society Annual Meeting, Las Vegas, NV.

6. **Fried NT, Oshinsky ML.** "The role of adenosine signaling, mitochondrial dysfunction, and glutamate signaling in delayed-ethanol-induced-headache in two rat models of migraine." June 2015 38th annual Research Society on Alcoholism Scientific Meeting, San Antonio, TX.
7. **Fried NT, Oshinsky ML.** "The (R)-isomer of isometheptene, decreases trigeminal sensitivity in a rat model of primary headache." June 2015 American Headache Society Annual Scientific Meeting, Washington, DC.
8. **Fried NT, Oshinsky ML.** "Mitochondrial Dysfunction in the Development of Trigeminal Sensitivity in a Chronic Migraine and Spontaneous Trigeminal Allodynia Rat Model." May 2015 International Headache Congress, Valencia, Spain.
9. **Fried NT, Oshinsky ML.** "Repeated infusion of prostaglandin E2 onto the dura induces chronic trigeminal sensitivity via TRPA1 channels." June 2014 American Headache Society Scientific Meeting, Los Angeles, CA. | November 2014, Society for Neuroscience Meeting, Washington DC.
10. **Fried NT, Oshinsky ML.** "The Role of Mitochondrial Dysfunction in the Development of Chronic Migraine." May 2014, The 9th Annual NIH Pain Consortium Symposium on Advances in Pain Research, Bethesda, MD. (*INVITED POSTER PRESENTER*)
11. **Fried NT, Oshinsky ML.** "The role of adenosine and mitochondrial dysfunction in delayed-ethanol-induced-headache." June 2014, 37th annual Research Society on Alcoholism Scientific Meeting, Bellevue, WA.
12. **Fried NT, Moffat C, Seifert EL, Oshinsky ML.** "Reduced Spare Respiratory Capacity in a Rat Model of Migraine." June 2013 International Headache Congress, Boston, MA.
13. **Hirata H, Fried NT, Oshinsky ML.** "Short exposure to intense tear hyperosmolarity leads to functional alterations of the corneal nerves involved in tearing and/or ocular pain." March 2013 The Association for Research in Vision and Ophthalmology Annual Meeting Seattle, WA
14. **Fried NT, Moffat C, Seifert EL, Oshinsky ML.** "Mitochondrial dysfunction in a rat model of chronic migraine." October 2012 Society for Neuroscience Annual Meeting, New Orleans, LA (*Endorsed by Seahorse Bioscience and reprinted for publication and in a press release.*)
15. **Khandelwal P, Schuster J, Fried NT, D'Cruz T, Lee J, Saunders A.** "Identification Of Regulators Of APP Metabolism On Chromosome 10" July 2008 International Conference on Alzheimer's Disease, Chicago, IL
16. **Fried NT, Khandelwal P, Saunders A.** "Identification of HDACs involved in APP metabolism" March 2008 Drexel's CoAS Research Day, Philadelphia, PA; April 2008 (Drexel Research Day – 1st prize)
17. **Reddy M, Wong J, Fried NT, Prabhakar U.** "Human IL-12/23 mAb inhibits Cutaneous Lymphocyte Antigen, IL-12R, and IL-2Ra expression on activated peripheral blood T lymphocytes and secretion of IFN- γ , IL-17, IL-2, IL-10, and TNF- α cytokines" April 2006, Society for Investigative Dermatology, Philadelphia, PA; July 2006, Centocor Science Poster Day, Radnor, PA

Invited Talks

1. NIH IRACDA Annual Teaching & Research Conference, Atlanta. "Obstacles for first-generation low-income students and institutional strategies to improve their success and retention." 2018
2. NIH IRACDA Annual Teaching & Research Conference, Atlanta. "How do you know a mouse is in pain?" 2018
3. Thomas Jefferson University Headache Clinicians Meeting. "CGRP and high-speed imaging of rodent headaches." 2018
4. Postdoctoral Research Highlights Seminar at Drexel University, "High-speed imaging of mouse pain behavior." 2018
5. Communicating Your Science Conference at Drexel University, "Sharing your science on social media." 2017
6. Rutgers Dept. of Biology Seminar Series, "Genetic investigation of peripheral neural circuits and mediators of pain." 2017
7. Tonix Pharmaceuticals Key Opinion Leader Meeting. "Isometheptene isomer effects on rat model of primary headache." 2015
8. American Headache Society Annual Meeting, "Isometheptene: It works, but for the wrong reason." 2015
9. University of Texas at Austin Seminar, "Unraveling basic migraine physiology by defining how alcohol affects trigeminal pain." 2015
10. Thomas Jefferson University Headache Clinicians Meeting, "Bringing back isometheptene, at least partially." 2015
11. Thomas Jefferson University Headache Clinicians Meeting. "Mitochondrial and Migraine: Potential Therapeutic Targets." 2014

Research Experience

Rutgers University, Camden, NJ

Assistant Professor and Assistant Director for Undergraduate Research & Education (sleep and pain), September 2018 to Present

- Developing an undergraduate-driven summer research program utilizing high-speed imaging, statistical modeling, and machine learning to characterize pain behaviors in drosophila in an effort to uncover the genetic and neural networks behind the intersection between sleep and pain.
- Integrated my research interests in pain and sleep into the year-round experiential research biology curriculum.
- Developed courses in science writing and research training while participating in curriculum development and career building activities for undergraduate majors in biomedical research fields.
- Continued an active role in efforts to increase diversity in the biomedical sciences through pursuit of NIH/NSF diversity-related grant applications.

University of Pennsylvania, Philadelphia, PA

IRACDA Postdoctoral Fellow (chronic pain), October 2015 to August 2018

- Utilized mouse genetics, calcium imaging, neuronal tracing, virus injection, optogenetics, and behavior to investigate central and peripheral brain circuitry of pain. Developed a behavioral platform that combined high-speed imaging, statistical modeling, and machine learning to determine the intensity of pain in rodents as a screening tool for new non-addictive pain therapeutics.
- As an Institutional Research and Academic Career Development Award (IRACDA) PENN-PORT Fellow, trained to design and teach college-level courses in minority-serving institutions throughout the Philadelphia region. These responsibilities are balanced with a full-time research program.
- Directly mentored high school, college, and graduate students on independent research projects.

Thomas Jefferson University, Philadelphia, PA

PhD Candidate (chronic migraine), September 2010 to September 2015

- Designed, implemented, and analyzed rodent studies using neuropharmacology, electrophysiology, behavior, and cellular biology techniques to investigate pathophysiology behind migraine, headache, and post-traumatic headache.
- Directly designed research proposals and consulted with multiple large and small pharmaceutical & biotechnology companies to test mechanisms of action and efficacy of novel drug candidates and medical devices on multiple rat models of trigeminal pain in the treatment of migraine headache.

Drexel University, Philadelphia, PA

Research Lab Manager/Web Developer, August, 2008 to August, 2010

- Provided technical support/troubleshooting for the Cell Imaging Center, Flow Cytometry Center, and the RNAi Resource Center as a lab manager.
- Designed, Developed, & Implemented Websites for the Department of Biology.
- Communicated various accomplishments and news about the Department of Biology to the University community and the Philadelphia area.

Drexel University, Philadelphia, PA

Student Research Assistant with Dr. Aleister Saunders (Alzheimer's Disease), April 2005 to June 2008

- Performed a chromosome-wide screen for genes that affect Amyloid beta plaque formation, a key contributor to Alzheimer's disease, with the use of shRNA in a novel APP-Gal4-SY5Y cell line.
- Developed methods of Amyloid beta subtype separation using Electrophoresis and Mass Spectrometry.

Centocor, Radnor, PA

Co-op/Assistant Scientist (multiple sclerosis), September, 2005 to April, 2007

- Investigated cytokine profile of whole blood samples using flow cytometry to determine mechanism of CNT01275 monoclonal antibody therapeutic.
- Created validation report to confirm fixative tube effectiveness in preserving biomarkers in active states for clinical application in future studies.

Baxter Healthcare, Cherry Hill, NJ

Co-op/QC Chemist, September, 2004 to April, 2005

- Confirmed purity of drugs in a Good Manufacturing Practicing Laboratory using HPLC & GC systems and various wet chemistry techniques.

Teaching Experience

Rutgers University, Camden, NJ

Assistant Professor and Assistant Director for Undergraduate Research & Education, September 2018 to Present

- Courses Taught: Pathophysiology, Exploring Careers in Biology, Statistics for Biological Research (CURE-based), Principles and Practices of Biological Research (CURE-based).
- Courses Developed and Taught: Neuroscience of the Opioid Epidemic, Science Writing

Rutgers University, Camden, NJ

Visiting Professor, Spring 2018, Class Size: 3 students, Recommended Text: Principles of Neural Science

- Designed new special topics in biology 3-credit course, "Neuropharmacology: Sensory Systems, Addiction, and Society", for undergraduate and graduate students as a Penn-PORT IRACDA fellow, focusing on pain and addiction and their intersection with the opioid epidemic across the region.
- Developed lecture material, assessments, learning objectives, and in-class activities. This course was team-taught with a Penn-PORT colleague and closely mentored by an Associate Professor of Biology.

Delaware County Community College, Media, PA

Visiting Professor, Spring & Fall 2017, Class Size: 26 students, Recommended Text: Anatomy and Physiology: The Unity of Form and Function

- Designed and delivered lecture material and student assessments as a Penn-PORT IRACDA fellow for 4-credit Anatomy & Physiology I course.
- Worked closely with faculty and students to identify unique characteristics of student population to provide enhanced mentorship and training to students from diverse backgrounds.

Thomas Jefferson University, Philadelphia, PA

Mathematics Instructor & Physics Teaching Assistant, August 2013 to Present, Class Size: 50+ students,

- Developed and presented math review classes for students in the Post-Bach program. This review is provided twice a year.
- Instructed, graded, supported, and designed laboratories as a teaching assistant for Physics I & II from August 2013 – June 2014.

Journalism Experience

Pain Research Forum & RELIEF at the International Association for the Study of Pain (IASP), Freelance Science Journalist, June 2016 to Present

- Wrote stories about recent discoveries in pain research for basic science researchers & clinicians in Pain Research Forum and the public in RELIEF.
- Performed phone interviews with those involved in studies and those who were not to create a well-balanced and informed story of recent findings.
- These two resources are accessed by the leading clinicians and basic scientists in the pain community.

Cactus Communications, Freelance Science Copy Editor, February 2016 to September 2016

- Edited scientific manuscripts for ESL researchers across the globe. Featured as worldwide top-ten most productive editor in the neuroscience group.

American Association for Cancer Research, Freelance Science Writer, June 2014 to June 2015

- Reviewed scientific manuscripts to write *Research Watch* and *In This Issue* summaries for the AACR peer-reviewed journal, *Cancer Discoveries*.

Integrative Academic Solutions, Columnist, March 2013 to June 2014

- Featured a number of articles regarding how skill-sets developed outside of graduate school are essential for success on or off the bench.

The Neuron Project, Editor in Chief, 2011 to 2014

- Designed, developed, and founded an online neuroscience magazine for fellow graduate students to write about current findings in neuroscience.

SFN's NeurOnline, Champion Writer, 2011 to 2012

- Led discussions about history, teaching, public awareness, and societal impact of neuroscience.

National Institute of Neurological Disorders and Stroke, Content Editor, 2011

- Edited and wrote descriptions of migraine-related disorders.

The Triangle, Drexel Student Newspaper, Lead Scientific Writer, 2009

- Wrote featured articles about current findings in research labs across engineering and biological sciences.

Positions Held in Organizations

- Web developer for the Philadelphia Chapter of SFN 2011 - Present
- Standing member on the Publications committee in the Research Society on Alcoholism 2013 - 2015
- Founding member of the Thomas Jefferson University Business and Biotech Group (BizBio) 2012 - 2014
- VP of Career Development, Graduate Student Association 2012 - 2014
- Graduate Student Liaison for TJU Neuroscience Department 2011 - 2013
- President of NSCS Honor Society Drexel Chapter September 2006 - 2008
- Vice President of NSCS Volunteer Activities 2006

Activities & Volunteer Work

- Academic reviewer at PLOS ONE, Cephalalgia, Journal of the Neurological Sciences, Cellular Physiology and Biochemistry, and Experimental Brain Research. 2016 - Present
- Volunteer at the Carolina Cannabinoid Collaborative Conference 2016
- Tutoring mathematics, physics, neuroscience, biology, and genetics 2008 - 2016
- Bioko Biodiversity Protection Program; Bioko Island, Equatorial Guinea 2010
- Archelon: Sea Turtle Protection Society of Greece Volunteer; Peloponnese, Greece 2008
- Three month expedition, navigation, and research of Sargasso Sea by Sail 2008
- Volunteer at Franklin Institute Interpretive Services Department 2004

Science and Diversity Outreach Work

- Invited speaker at Cafe Scientifique in Woking, United Kingdom at the LightBox art gallery, "Networks: from cyber to transport to neural." 2018
- Invited monologist at "Without Order" performance, "The Neuroscience of Self-Preservation." 2018
- Poster judge for Penn's Office of Research & Diversity Training Symposium 2018
- Invited speaker at Taste of Science Festival, "We don't have an opioid epidemic; we have a chronic pain management epidemic." 2018
- Invited speaker at University of Pennsylvania's Biological Basis of Behavior Society, "How to tell a mouse is in pain." 2018
- Invited speaker at TimeCamp001 science fiction conference hosted by Afrofuturist Affair, "How the brain perceives time." 2017
- Invited speaker at Philadelphia Science Festival's Sensory Overload at Yard's Brewery, "Synesthesia, LSD, and the rewiring of our senses." 2017
- Invited speaker at Washington Township High School, "Alcohol, the Brain, and Migraines" 2017
- Resident Neuroscience Expert with NeuroNewsNight monthly Twitter Chat 2016
- Invited speaker at Lincoln University (HBCU), "Insider secrets for getting into graduate & medical school" 2016
- Poster judge for Penn Honors Diversity Symposium 2016
- Co-organized graduate school prep day for Penn's Summer Undergraduate Internship Program 2016
- Philadelphia Brain Health Fair 2014
- Coalition for the Life Sciences Capitol Hill Day 2014
- SFN Brain Week activities 2011 - 2014

Special Courses/Workshops

- CrawFly neurophysiology course for invertebrate undergraduate research/teaching at Cornell University 2018
- NAFSA's Global Learning Colloquium in Science, Technology, Engineering, Arts, Mathematics and Design 2018
- Improving STEM Education Through Research, Drexel University, (auditing 3 credit course) 2018
- Overcoming barriers to effectively utilize *Drosophila* in research/teaching at PUIs workshop, 59th Annual Drosophila Research Conference 2018
- College and University Teaching Seminar (focused on developing teaching philosophy and teaching at a university level), UPenn 2017
- HHMI-BioInteractive Teaching Workshop PENN 2016
- Biotechnology Venture Management Class, TJU 2012

Independent Research Students Mentored

- Undergraduate student (Swarthmore College) 2017 - 2018
- High school student (Friend's Central) 2016 - 2017
- High school student (Science Leadership Academy) 2016 - 2017
- PhD rotation student (University of Pennsylvania) 2016
- Undergraduate student (Williams College) 2016
- High school student (Downingtown STEM Academy) 2016
- Undergraduate student (University of California, Irvine) 2014
- High school student (STEMM Prep Project for underrepresented future scientists) 2013 - 2015